

## A literature review on impact of COVID-19 and current immunization status: The Indian scenario

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### ABSTRACT

SARS-CoV-2 is a highly infectious and deadly coronavirus that first appeared in late 2019 and has since created a pandemic of the acute respiratory disease known as "coronavirus disease 2019" (COVID-19). This literature aims to summarise current knowledge of COVID-19's clinical, epidemiological, structural, and pathological aspects, as well as the timeline of spread and recent progress in India's immunization effort. A literature review was conducted through the database of Google Scholar and the official website of the Ministry of Health and Family Welfare Government of India. All the latest studies regarding knowledge, prevention, and details related to COVID-19 were utilized. The outcome indicated that India is the world's second-most affecting coronavirus region. The adaptability of mutant virus and disobedience to CAB are the leading causes of the rising spread, therefore, having common symptoms of fever, sore throat, cough, and general weakness. This study reported that the number of COVID-19 cases has spread throughout the world, has caused an increase in morbidity and mortality in the population. The improvement of the immunization programme, on the other hand, has opposite impact on mortality rate.

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### Introduction

The name "coronavirus" derives from the Latin word "coronam," which means a crown since there are spikes that appear like a crown on the outer surface of the coronavirus. They are very tiny in diameter from 65 - 125 nm. The genetic material of the virus is a single strain RNA of size range 26 - 32 kilobases (kb). The coronavirus sub-groups are alpha ( $\alpha$ ), beta ( $\beta$ ), gamma ( $\gamma$ ), and delta ( $\delta$ ). In December 2019 a group of people was diagnosed with an unknown disease having similar symptoms to pneumonia.

The background study of these people defines that they are linked with seafood, and wet animals from Wuhan, China wholesale market. The causative agent was identified and named as the novel coronavirus of that mysterious disease. The International Committee for Virus Taxonomy (ICTV) has changed the name of the novel coronavirus to SARS-CoV-2, which can cause the disease known as COVID-19 (1).

### Definition

COVID-19 comes from the family Coronaviridae, which is responsible for the spread of acute respiratory infection. COVID-19 affects worldwide and now mutation like the virus has been reported, it has elevated mortality and morbidity rates all over the world (2). Coronaviruses are a large group of animal-origin viruses that have caused SARS-CoV-2 (Severe Acute Respiratory Coronavirus 2) out-break of the COVID-19 pandemic. The greater risk of infection with COVID-19 is among older adults, juveniles, and patients with chronic disease (3).

### Epidemiology

COVID-19 has impacted worldwide since December 2019. It is an acute respiratory chronic condition caused by SARS-CoV-2. It is very widespread. The first case was registered in Wuhan, China in December 2019 (4). As of 23rd January 2022, 340,543,962 patients have been diagnosed with COVID-19 Worldwide out of which 5,570,163 deaths have been reported (5), and in India, 39,237,264 people have been diagnosed with it and 489,409 deaths have been reported according to the official website of World Health Organization (6). The situation of COVID-19 in India is mentioned in tabular form in **Table 1**.

### Structure of SARS-CoV-2 and infiltration into host cells

#### Structure of SARS-CoV-2

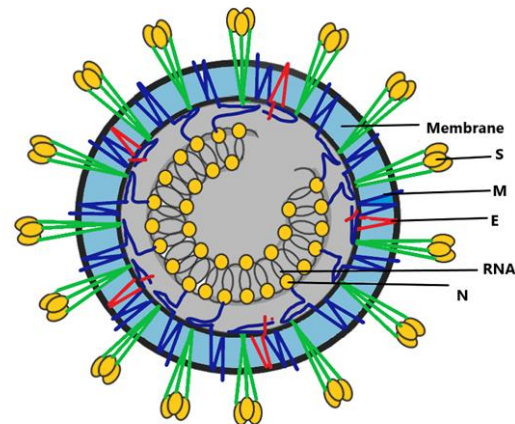
SARS-CoV-2's four structural proteins are mentioned in **Figure 1** (2).

- Spike protein (S)
- Envelop protein (E)
- Nucleocapsid protein (N)
- Membrane protein (M)

Out of which-

- S protein has two S1 and S2 subunits, S1 is responsible for binding, and S2 encourages infiltration of the host cell.

- N protein contributes to the binding with new genomic RNA.
- M protein provides integration to the cellular endoplasmic reticulum (ER)



**Figure 1.** SARS-CoV-2's Structural proteins

#### Life Cycle and Infiltration into Host Cells

SARS-CoV-2 is disseminated by physical engagement with person to person, person to surface, and surface to person through infected respiratory droplets by cough and sneeze. After getting access to the host's body, the virus gets attached to the ACE-2 receptor and enters the cell by the process of endocytosis or membrane fusion (Ouassou et al., 2020). Many researchers claim that ACE-2 has been identified as a functional receptor for SARS-CoV-2 and is strongly expressed on the pulmonary epithelial cells. First, the S protein binds to the host receptor, and then the virus invades the start cells being presented to the start of the lymphocyte cells. Following the binding of SARS-CoV-2 to the ACE-2, the S protease undergoes proteolysis by two steps: the first begins at the S1 cleavage site and terminates at the ACE2 fusion site, and the second expands from an adjacent peptide of the S2 protein at the S2 fusion. These researchers propose that the initial bond-forming of the S2 subunit at the attachment site of the virus to the host cell is essential for virus particle stabilization, but that the virus uses altered conformation to cause cell-linked fusion, thereby rendering the rest ineffective. As the post-membrane phase of viral infection occurs, the virus enters the pulmonary alveolar cells and is released into the airways. Thus, the synthesis of the negative strand of pre-separated RNA by RNA polymerase action (transcription) takes place in the host cell before replication, and synthesis of the positive strand of RNA follows afterward. These newly-formed RNA complexes, containing the old chain of positive RNAs, then initiate positive RNAs, proceed to synthesize new proteins in the cytoplasm (translation). New genes,

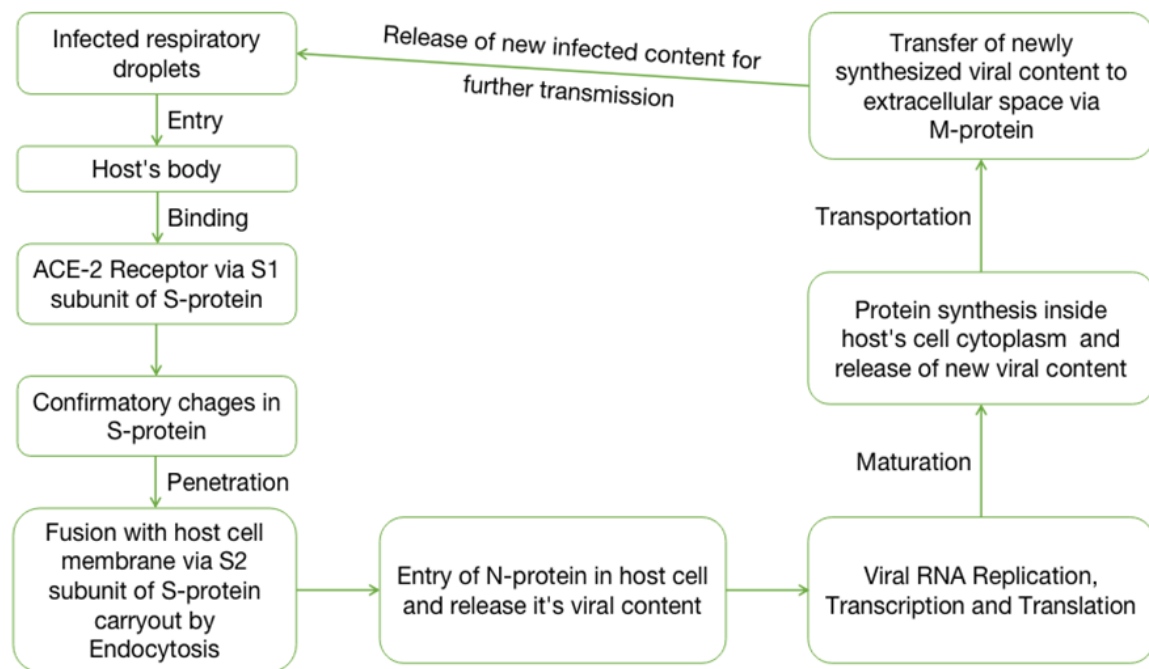
**Table 1.** Projections of COVID-19 cases in India till 23/01/2022.

State/UT	Confirmed cases	Active cases	Recovered cases	Deceased cases
Andaman and Nicobar Islands	9,277	564	8,584	129
Andhra Pradesh	2,166,194	73,143	2,078,513	14,538
Arunachal Pradesh	59,162	2,890	55,990	282
Assam	690,534	49,017	635,229	6,288
Bihar	808,754	19,579	776,992	12,183
Chandigarh	84,884	8,614	75,170	1,100
Chhattisgarh	1,091,868	31,181	1,046,971	13,716
Dadra and Nagar Haveli and Daman and Diu	11,172	238	10,930	4
Delhi	1,782,514	58,593	1,698,335	25,586
Goa	227,856	21,383	202,871	3,602
Gujarat	1,045,938	129,875	905,833	10,230
Haryana	901,303	57,955	833,183	10,165
Himachal Pradesh	259,566	17,295	238,340	3,931
Jammu and Kashmir	390,949	39,113	347,238	4,598
Jharkhand	419,158	21,628	392,277	5,253
Karnataka	3,467,472	330,477	3,098,432	38,563
Kerala	5,597,648	247,938	5,297,971	51,739
Ladakh	24,496	1,275	22,999	222
Lakshadweep	10,743	258	10,434	51
Madhya Pradesh	882,906	61,388	810,956	10,562
Maharashtra	7,466,420	283,731	7,040,618	142,071
Manipur	129,661	3,139	124,500	2,022
Meghalaya	88,141	2,002	84,643	1,496
Mizoram	159,653	9,845	149,227	581
Nagaland	33,478	642	32,131	705
Odisha	1,196,140	76,859	1,110,767	8,514
Puducherry	150,316	15,068	133,347	1,901
Punjab	707,847	48,564	642,335	16,948
Rajasthan	1,115,790	89,233	1,017,481	9,076
Sikkim	36,765	2,473	33,871	421
Tamil Nadu	3,103,410	194,697	2,871,535	37,178
Telangana	731,212	31,199	695,942	4,071
Tripura	97,933	8,143	88,922	868
Uttarakhand	396,674	28,907	360,292	7,475
Uttar Pradesh	1,933,165	96,642	1,813,485	23,038
West Bengal	1,958,265	123,657	1,814,306	20,302
<b>Total</b>	<b>39,237,264</b>	<b>2,187,205</b>	<b>36,560,650</b>	<b>489,409</b>

which may have been inherited from a different mother, bind to the endoplasmic reticulum on the viral N protein, and activate cellular DNA-sequence-specific replication to complete the retrotransposition. These freshly produced Nucleic acids are delivered to the cell through the Golgi apparatus and exocytosis. Epithelial cells will now have a chance to become infected and have ready particles to present on respiratory tract mucus, with the new virus having completed the preparation

phase. An overview of the viral cycle is given, especially in regards to the topics of infection, infection transmission; incubation, replication, and how the virus interacts with its host are included in **Figure 2** (Parasher, 2020).

### Scenario of covid-19 in India



**Figure 2.** Flowchart of SARS-CoV-2's life cycle and infiltration into host's cells.

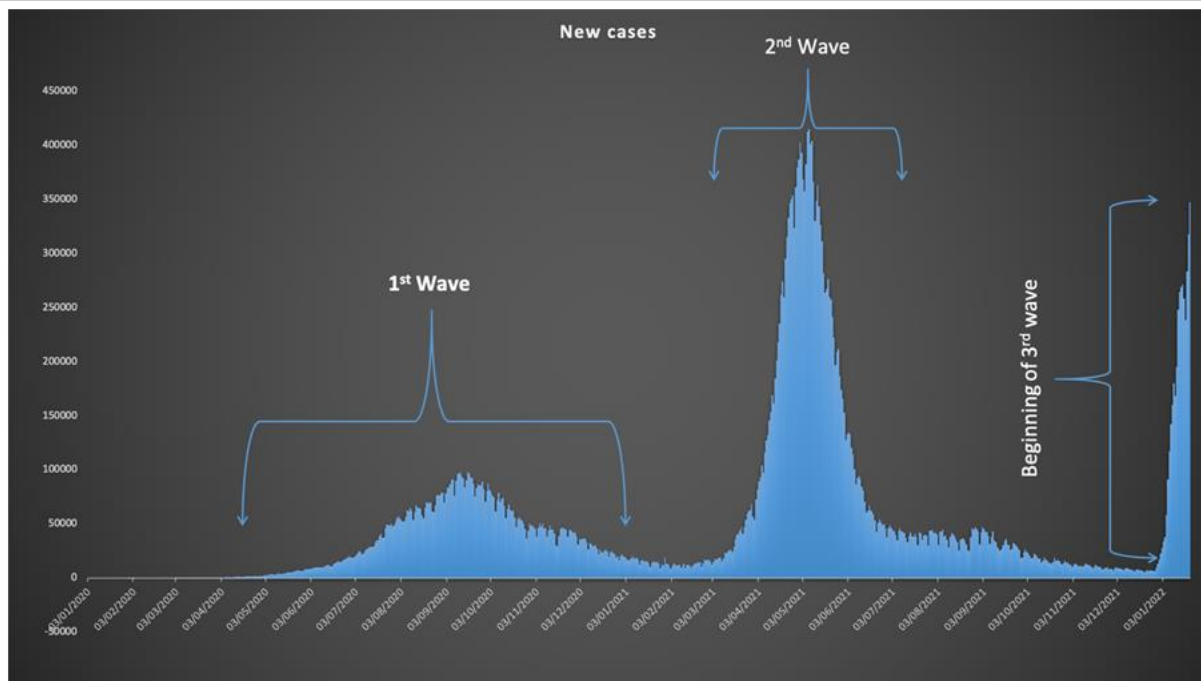
### Timeline of COVID-19 in India

In India first case of COVID-19 was reported on 27th January 2020 in Kerala, from there onwards cases of COVID-19 rose, and a terrible disease was spread across the country. To control the situation government declared its first lockdown on 23rd March 2020 (7). The unlocking process was initiated on 1st June 2020 after proper lockdown since 23rd March 2020, as unlock process progressed from 1<sup>st</sup> unlock to 5th unlock restrictions were being lifted by the government as unlocking progressed to the next stage and the residents of India also started to take COVID-19 for granted and decrease their practice of safety measures and liberal approach towards COVID-19 which lead to the rapid increase in confirmed cases in India since unlock (8,9). As of 11th January, 2021 education institutes like schools and colleges were opened by the government, Initially, education institutes were being operated with limited strength but in mid of February 2021, education institutes were being operated with full strength, and exams were being conducted offline due to which physical distancing was not maintained and social gathering was promoted due to which there was the rapid increase in confirmed new cases of COVID-19 and 2nd wave of COVID-19 was began from 02 March 2021 (10). The second wave, sparked by the Delta variety, drone hospitals to breaking point, resulting in extraordinary demands for oxygen and life-saving medication. The higher number of cases in the second wave was due to a

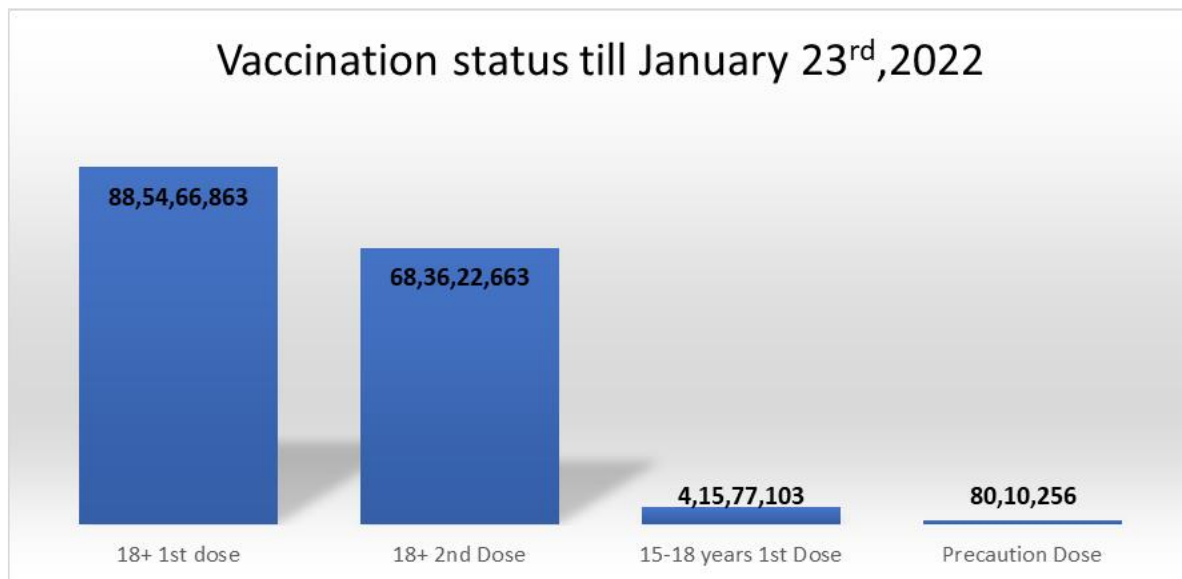
variety of reasons. One of the concerned causes was always been widespread disrespect for the Covid Appropriate Behaviour or 'CAB' by the public. Also, the mutant virus has been found to have a greater ability to transmit and a shorter incubation period to prior variant. In the second wave, in addition to older people, pediatric and younger people were infected. As the surge was started, the central government gave full rights to the state government on March 23, 2021, w.e.f April 1, 2021, according to which states were regulated (11). India has seen 1.7 million covid cases and thousands of death in just two months. In total, India reported almost 1.2 lakh deaths in May and an additional 67,000 in June, the pandemic's two deadliest months. The number of deaths fell sharply in July as the second wave faded, and continued to fall in subsequent months as India's vaccine program ramped up (12). In the eleventh month of the year 2021, there was a new mutation in the Coronavirus and the variant B.1.1.529, also known as Omicron has been identified as a variant of concern by WHO (13). The third wave is caused due to new mutant of the virus that has the capability to overcome existing immunity and is more transmissible and relaxation of government on CAB (14,15). The timeline of daily new cases of COVID-19 can be seen in **Figure 3**.

### COVID-19 Vaccination/ Immunization Program of India

The immunization/vaccination program of SARS-CoV-2 in India was started on 16th January 2021.



**Figure 3.** Projection of new confirmed cases till January 23<sup>rd</sup>, 2022.



**Figure 4.** Vaccine administered till January 23<sup>rd</sup>, 2022.

The vaccination program is started with two vaccines after their Emergency Use Authorization (EUA) approval from CDSCO on 1st January 2021 after completion of clinical trial phase 3. Vaccines that are being approved for this program till January 23<sup>rd</sup>, 2022 are COVISHIELD (Oxford-AstraZeneca) manufactured by Serum Institute of India, COVAXIN manufactured by Bharat Biotech, and Sputnik V manufactured by Dr. Reddys Laboratories Limited and Sputnik LLC (16,17). COVID-19 vaccination program will be conducted in Phases, now phase 3

and phase 4 of the COVID-19 vaccination program is being conducted at a progressive rate.

Phase 1: In this phase vaccination of healthcare professionals and front-line workers was done.

Phase 2: In this phase, those above the age of 60, as well as those between the ages of 45 and 59 that have comorbid conditions will receive the vaccine.

Phase 3: This phase was begun on 1<sup>st</sup> May 2021.

**Table 2.** Number of citizens who have been vaccinated in various states of India.

State/UT	Beneficiaries vaccinated				Total
	18+ Population		15-18 Years	Precaution Dose	
	1st Dose	2nd Dose	1st Dose		
A & N Islands	3,07,962	2,99,423	16,279	3,799	6,27,463
Andhra Pradesh	40,314,056	34,790,500	2,348,963	492,745	77,946,264
Arunachal Pradesh	834,433	674,178	33,879	12,095	1,554,585
Assam	22,225,230	17,524,773	832,536	106,695	40,689,234
Bihar	59,891,948	45,880,268	3,498,938	359,331	109,630,485
Chandigarh	1,069,107	840,022	35,034	10,627	1,954,790
Chhattisgarh	18,235,874	13,568,508	924,463	169,755	32,898,600
Dadra & Nagar Haveli	421,982	310,190	17,979	1,757	751,908
Daman & Diu	297,278	249,090	11,196	2,276	559,840
Delhi	16,093,066	12,137,690	741,343	210,320	29,182,419
Goa	1,334,146	1,147,126	42,794	15,232	2,539,298
Gujarat	48,280,449	44,640,900	2,447,280	875,146	96,243,775
Haryana	21,396,328	16,270,287	874,218	103,118	38,643,951
Himachal Pradesh	5,976,036	5,544,479	295,237	68,020	11,883,772
Jammu & Kashmir	9,828,492	9,700,903	521,193	123,164	20,173,752
Jharkhand	20,146,368	12,589,965	852,777	101,485	33,690,595
Karnataka	48,929,468	41,725,491	2,140,044	472,779	93,267,782
Kerala	26,753,866	22,268,605	1,007,702	363,779	50,393,952
Ladakh	217,300	177,157	7,776	8,479	410,712
Lakshadweep	56,554	53,538	2,795	1,589	114,476
Madhya Pradesh	53,472,332	51,098,094	3,506,690	529,974	108,607,090
Maharashtra	82,743,280	59,767,688	2,932,864	599,892	146,043,724
Manipur	1,357,205	1,032,482	31,083	14,929	2,435,699
Meghalaya	1,290,653	925,899	31,928	15,420	2,263,900
Mizoram	764,097	605,621	38,790	12,950	1,421,458
Nagaland	801,041	603,697	28,067	8,244	1,441,049
Odisha	30,318,429	23,598,099	1,290,387	352,149	55,559,064
Puducherry	877,327	598,913	39,832	5,207	1,521,279
Punjab	18,557,169	11,907,868	199,463	75,985	30,740,485
Rajasthan	48,923,540	38,561,982	2,757,653	620,212	90,863,387
Sikkim	534,805	488,788	21,090	11,435	1,056,118
Tamil Nadu	51,999,710	37,644,412	1,958,065	206,110	91,808,297
Telangana	28,767,445	22,085,579	1,077,538	212,994	52,143,556
Tripura	2,623,364	2,159,173	107,775	30,391	4,920,703
Uttar Pradesh	143,711,097	95,527,475	7,800,084	769,818	247,808,474
Uttarakhand	8,016,983	6,835,835	375,306	140,033	15,368,157
West Bengal	66,168,307	48,515,514	2,728,062	566,761	117,978,644
Miscellaneous	2,238,098	1,571,874	0	335,561	4,145,533
Total	885,466,863	683,622,663	41,577,103	8,010,256	1,618,656,807



Those above the age of 18 were eligible to receive the vaccine (18).

Phase 4: This can be called a booster dose and vaccination for children. COVID-19 vaccination for children between the ages of 15 and 18 has begun on January 3rd, 2022. Only Covaxin could be a choice for such beneficiaries. Also, health care workers (HCW's), front-line workers (FLW's), and all persons aged 60 and above 45 with comorbidities who have received two doses of COVID-19 immunization can take the precautionary dose on doctor's advice effective from January 10th, 2022. This booster dose prioritization and sequencing would be based on the completion of 9 months or 39 weeks from the date of 2nd dose administration (19).

According to the COVID-19 vaccination program all who come under eligibility criteria can get vaccinated after getting enrolled in vaccination drive through the COWIN portal. The central government has enrolled all government hospitals, various private hospitals, and several camps at public places (like schools, colleges, and community centers) throughout the country (18). As of January 23rd, 2022, 7:00 am the total number of vaccines administered is given in **Figure 4**. The maximum number of citizens to get vaccinated is of Uttar Pradesh that is 247,808,474 followed by citizens of Maharashtra that is 146,043,724, and data of the total number of citizens get vaccinated till January 23rd, 2022 in different states of India is given in **Table 2** (20).

### Indications and symptoms

The indications and symptoms of COVID-19 are based on their frequency of occurrence as seen in **Table 3** (21).

### Complications

Complications of COVID-19 are listed below in the chart in **Figure 5** (22).

### Risk factor

- Obesity: Obesity raises the likelihood that COVID-19 will induce serious illness (23).
- Smoking: Smokers are 1.5 significantly more likely to occur serious COVID-19 complications (24).
- Alcohol: Alcohol impairs the body's ability to fight infections such as COVID-19 (25).
- Physical inactivity: The avoidance of heart disease, obesity, and diabetes control are all correlated with physical exercise, which are risk factors for extreme COVID-19 (26).

- Pollution: Air pollution compromises lung function, which increases the risk of respiratory infections including COVID-19 (27).
- Diabetes: Diabetic people are 3 times more likely to have serious COVID-19 symptoms or die from COVID-19 (28).
- Cardiovascular disease: Increases the possibility of serious COVID-19 (29).
- Respiratory disease: Patients with chronic COPD are at risk of extreme COVID-19 complication or death (30).
- Cancer: The COVID-19 mortality risk has risen dramatically in patients with cancer and has been especially high in people with blood cancer (31).

## DIAGNOSIS

### Molecular test (RT-PCR)

It is highly accurate to find out viral genetic material from the patient's body to confirm the diagnosis. The samples are obtained through nasopharyngeal swabs from the upper respiratory tract and preserved at 4°C before being sent to the laboratories. This test becomes positive after 2-7 days of getting the infection. It gives a result within 1-2 days (2).

### Antibody detection test

This test is having a rapid result. This test was developed for rapid diagnosis, it requires a very low quantity of blood as a sample. It gives the result within 15-30 minutes (32).

### Chest x-ray

This test is not showing significant results, it is helpful when the infection is in severe condition (2).

### Hematological test

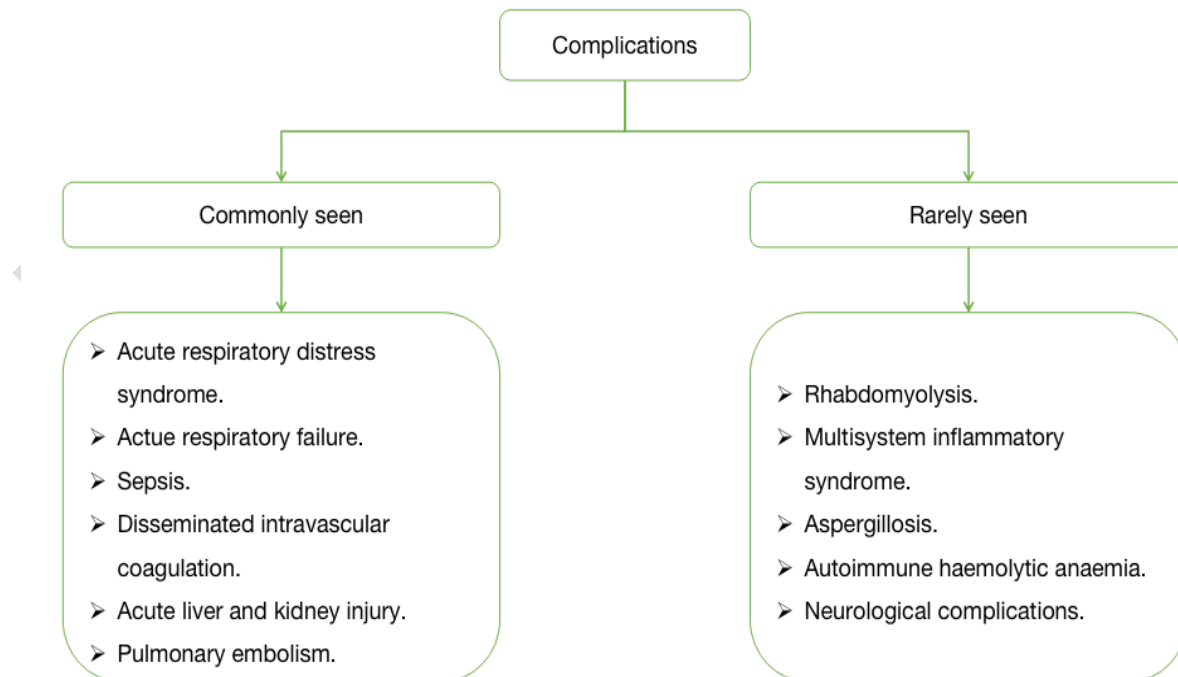
Lymphocytes, monocytes, and leukocytes count, lactate dehydrogenase, calcitonin, troponin, myoglobin levels, C-reactive protein, LDH, and ESR were observed for acute and chronic patients (32).

### Other laboratory tests

To improve quality of life some other laboratory tests like blood gas analysis, coagulation image, inflammatory factors, liver and kidney function test, myocardial enzymes, urine analysis can also be monitored (2,32).

**Table 3.** Indications and Symptoms.

Indications/Symptoms	Frequency
Fever	Prevalent
Dry cough	Prevalent
Fatigue	Prevalent
Loss of taste or smell	Less occurrence
Nasal congestion	Less occurrence
Conjunctivitis (also known as red eyes)	Less occurrence
Sore throat	Less occurrence
Headache	Less occurrence
Muscle or joint pain	Less occurrence
Different types of skin rash	Less occurrence
Nausea or vomiting	Less occurrence
Diarrhea	Less occurrence
Chills or dizziness	Less occurrence
Irritability	Less occurrence
Confusion	Less occurrence
Reduced consciousness	Less occurrence
Anxiety	Less occurrence
Depression	Less occurrence
Sleep disorders	Less occurrence
Shortness of breath	Unusual and critical
Loss of appetite	Unusual and critical
Persistent pain or pressure in the chest	Unusual and critical
Strokes	Unusual and critical
Brain inflammation	Unusual and critical
Delirium	Unusual and critical
Nerve damage	Unusual and critical

**Figure 5.** Complications of COVID-19.



## PREVENTION

Both government and public should follow the prevention guidelines of COVID-19 by WHO and the government. To reduce the chance of getting infection first do the following (33)-

- Maintain your place clean.
- Try to not sneeze and cough without tissue paper in public.
- Cover your mouth and nose with a mask during an outing in public.
- Proper cleaning of food material before eating and cooking.
- Try to avoid contact with investigational personnel regarding any respiratory problem or symptoms like COVID-19.
- Try to avoid traveling, stay at a particular place.
- Drink hot and lukewarm water.
- Clean hand with soap and alcohol-based hand rub.

## Conclusion

This study concludes that, the number of COVID-19 cases has expanded over the world, causing a rise in morbidity and death in the population. On the other hand, improvements in the vaccination programme have resulted in a lower death rate. In the lack of a good and efficient antibody test, the diagnosis is currently based on a reverse-transcription PCR of nasopharyngeal and oropharyngeal swab samples. Clinically, the disorder manifests as a mild, moderate, or severe sickness.

## Contribution of authors

SB, ST, and AKG: Major contributor in writing and drafting the manuscript, and AS: read and approved the final manuscript.

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## Conflict of interest

The authors declare no potential conflicts of interest regarding the research, authorship, and/or publication of this article.

## Statement of Ethics

Not applicable

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